NISTTech

ChemNose -Method for Operating a Sensor to Differentiate Between Analytes in a Sample

Low-power, accurate electronic olfactory 'nose' suitable for a wide range of applications

Description

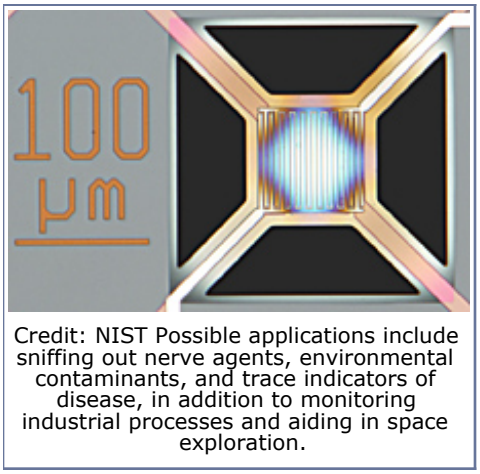
Combining a sensitive detector technology capable of distinguishing hundreds of different chemical compounds with a pattern-recognition module that mimics the way animals recognize odors results in a new approach for "electronic noses." ChemNose is adept at recognizing molecular features even for chemicals it has not been trained to detect and is robust enough to deal with changes in sensor response that come with wear and tear. The tunability of the new approach means that a variety of chemical warfare agents and toxic industrial chemicals in air-based backgrounds can be detected despite challenging interferences. New signal analysis schemes hold the potential for properly classifying "unknowns."

Among the attractive features inherent in ChemNose are small size (individual device structures are ~100 microns square, and unpackaged arrays fit on a 1 mm × 1 mm chip), low power consumption (battery operation), and tunability. Since it is fabricated through CMOS-compatible silicon technology, electronics can be added to enhance operational signal handling architectures and lower unit costs. Ease of integration and CMOS- compatibility aids coupling telemetry with the microsensors - thereby enabling network deployment. In addition, its robustness against the effects of sensor drift will facilitate its commercialization across a broad range of applications.

ChemNose is based on interactions between chemical species and semiconducting sensor materials placed on top of MEMS microheater platforms developed at NIST. Eight types of sensors in the form of oxide films are deposited on the surface of 16 microheaters, with two copies of each material. Precise control of each of the individual heating elements allows each to be treated as a collection of virtual sensors at 350 temperature increments between 150 to 500 deg C, thus increasing the sensor number to ~ 5,600. The combination of sensing films and the ability to vary the temperature gives the device the analytical equivalent of a snoot full of sensory neurons.

See NIST Dockets 92-045, 92-046, and 92-047

Images



Credit: NIST Possible applications include sniffing out nerve agents, environmental contaminants, and trace indicators of disease, in addition to monitoring industrial processes and aiding in space exploration.

Applications

- **First Responders**
  Ideal for emergency response teams at possible chemical spill sites
- **Chemical processing and transportation**
  Useful as a primary alert for potential exposure to numerous toxic industrial chemicals and chemical warfare agents
- **Homeland security**
  Identifies the presence of many dangerous chemicals and can classify lesser known substances

Advantages

- **Portable**
  Compact design of approximately 100 microns square
- **Network capable**
  Add CMOS-compatible and additional electronics directly to the chip for easy integration
- **Low power**

Battery operated

- **Autonomous**
  "All-in-one" design does not require additional components
- **Adaptable**
  Capable of classifying "unknown" chemical compounds in addition to being able to pin point specific chemical warfare agents and toxic industrial chemicals

Abstract

Disclosed is a method for operating a sensor to differentiate between first and second analytes in a sample. The method comprises the steps of determining a input profile for the sensor which will enhance the difference in the output profiles of the sensor as between the first analyte and the second analyte; determining a first analyte output profile as observed when the input profile is applied to the sensor; determining a second analyte output profile as observed when the temperature profile is applied to the sensor; introducing the sensor to the sample while applying the temperature profile to the sensor, thereby obtaining a sample output profile; and evaluating the sample output profile as against the first and second analyte output profiles to thereby determine which of the analytes is present in the sample.

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Citations

1.
   - ***Docket Number:*** 92-045
     U.S. Patent # 5,464,966
   - ***Docket Number:*** 92-046
     U.S. Patent # 5,345,213
   - ***Docket Number:*** 92-047
     U.S. Patent # 5,356,756

Related Items

- Article: Sniffing Out a Better Chemical Sensor
- Article: Microsensors Sniff Out Gases
- Article: Designing an Ultrasensitive "Optical Nose" for Chemicals

References

- U.S. Patent # 6,095,681 issued 08-01-2000, expires 07/28/2018
- Docket: 96-047US

Status of Availability

This invention is available for licensing exclusively or non-exclusively in any field of use.

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